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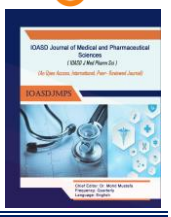

Status of some Toxic Heavy Metals, Oxidative Stress and Inflammatory Biomarkers Among Petty Traders in Swali Market Yenagoa Bayelsa State Nigeria

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ABSTRACT

Petty trading is an economic activity that involves the selling and buying of goods in small scale. This study was aimed on the status of some toxic heavy metals, oxidative stress and inflammatory biomarkers among petty traders in Swali market Yenagoa Bayelsa State Nigeria. Five milliliters blood specimens were collected from each of the one hundred and five participants and dispensed into lithium heparin anti-coagulated bottles respectively. These participants were further grouped into control group made up of 35 non petty traders, experimental group one made up of 35 petty traders with < 6 years petty trading experience and experimental group two made up of 35 petty traders with 6-12 years petty trading experience. All the participants were within the age bracket of 28-45 years. The collected blood specimens were spun with the aid of a colorimeter at 2,500 revolution / minute and used for the measurement of cadmium (atomic absorption spectrophotometry method), lead (atomic absorption spectrophotometry method), glutathione peroxidase (ultra violet method), malondialdehyde (thiobarbituric acid method), interleukin-6 (elascience method) and C-reactive protein (latex turbidimetry method) using SPSS 23.0 version as the statistical package with the results expressed as mean ± SD via the use of student "t" test analysis and considered significant at $p < 0.05$. The mean values of cadmium (0.05 ± 0.02) µg/dl, ($p = 0.91$), lead (0.22 ± 0.02) µg/dl, ($p = 0.87$), glutathione peroxidase (2.72 ± 0.22) µmol/L, ($p = 0.95$), malondialdehyde (2.87 ± 0.25) µmol/L, ($p = 0.92$), interleukin-6 (10.26 ± 0.97) pg/ml, ($p = 0.02$) and C-reactive protein (9.75 ± 0.52) mg/L, ($p = 0.02$) revealed no significant alterations among the participants in experimental group one with the exception of interleukin-6 and C-reactive protein as compared to the control group cadmium (0.04 ± 0.01) µg/dl, lead (0.20 ± 0.02) µg/dl, glutathione peroxidase (2.71 ± 0.19) µmol/L, malondialdehyde (2.84 ± 0.21) µmol/L, interleukin-6 (8.24 ± 0.83) pg/ml and C-reactive protein (4.72 ± 0.43)mg/L while in the experimental group two participants the mean values of cadmium (0.14 ± 0.02) µg/dl, ($p = 0.03$), lead (0.93 ± 0.03) µg/dl, ($p = 0.02$), glutathione peroxidase (4.85 ± 1.23) µmol/L, ($p = 0.02$), malondialdehyde (5.21 ± 1.30) µmol/L, ($p = 0.02$), interleukin-6 (12.66 ± 1.24) pg/ml, ($p = 0.01$) and C-reactive protein (14.72 ± 1.35) mg/L, ($p = 0.01$) were significantly elevated as compared to that of the control group: cadmium (0.04 ± 0.01) µg/dl, lead (0.20 ± 0.02) µg/dl, glutathione peroxidase (2.71 ± 0.19) µmol/L, malondialdehyde (2.84 ± 0.21) µmol/L, interleukin-6 (8.24 ± 0.83) pg/ml and C-reactive protein (4.72 ± 0.43) mg/L. In conclusion, petty traders with < 6 years trading experience may be prone to inflammatory disorder while those with 6-12 years trading experience may be at the risk of toxic heavy metals such as cadmium and lead poisoning, oxidative stress and inflammatory disorder. It is therefore recommended that these traders should go for occasional assessment of these parameters in a reputable medical laboratory facility

Keywords: Petty traders, toxic heavy metals, oxidative stress biomarker, inflammatory biomarker, status, Swali market, Yenagoa, Bayelsa State, Nigeria.

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1. INTRODUCTION

Women in both urban and rural areas generate income to fulfil their basic physical needs through economic activities, such as engaging in small-scale commercial ventures. This activity encompasses both agricultural and non-agricultural endeavours, including the processing of raw food resources like garri, maize, yam, or rice. It also involves marketing activities such as trading, as well as other microenterprises like rental firms (Hauwa V *et al.,* 2023).

Small-scale commerce plays a crucial role in a competitive economy and significantly outnumbers larger businesses. It requires less capital and does not rely on extensive infrastructure for operation (Hiproject, 2017). This trading involves a group of individual sellers with limited resources and purchasers who operate in a small number of available locations inside a specific area (Bedamie G, and Daniel T, 2016). The bulk of individuals engaged in this commerce conduct their commercial transactions at stalls, open spaces, roadside areas, and occasionally in makeshift stores within the villages.

This commerce is a significant informal business that employs a substantial number of individuals in cultures worldwide. The authors Mnyawi S, and Benedict G, (2014) highlight that this trade constitutes 62% of informal employment and serves as a primary source of income for the majority of Africans. In Africa, the practice of trading is more prevalent among women than men. These traders can be found in semi-urban regions, selling agricultural products and imported consumer items. According to Bedamie G, and Daniel T, (2016), this has enhanced the accessibility of goods and services in smaller quantities, at the appropriate location, correct rates, suitable format, and timely manner.

Small-scale merchants are vulnerable to airborne contaminants, which can potentially jeopardise their well-being. These symptoms include nausea, diarrhoea, headache, skin rashes, sunburns, and an elevated susceptibility to infections caused by extended exposure to inhaled chemical compounds included in air pollution which may lead to vital organs damage (Brauer M *et al,* 2008). The contamination and subsequent poisoning of the environment by heavy metals, to which petty traders are frequently exposed, has become a globally concerning issue. This is owing to the various sources, vast distribution, and multiple consequences on the ecosystem (Iyebor E *et al.,* 2020). The levels of harmful heavy metals in street dust and soils have significantly increased over the past 50 years due to a rapid and exponential growth in the utilisation of heavy metals in industrial activities (Mwachuke R, and Okiri P., 2013). This has been linked to various harmful health consequences, including the development of asthma and increased risk of death.

Despite the reports mentioned by these researchers and a few others, many individuals have resorted to small-scale trading as a result of the challenging economy and limited job opportunities, without taking into account the potential risks associated with exposure to and inhalation of air pollutants such as lead, cadmium, carbon monoxide, and particulate matter ($PM_{2.5}$), which pose significant health hazards. This study was conducted to investigate the status of some toxic heavy metals, oxidative stress and inflammatory biomarkers among petty traders in Swali market Yenagoa Bayelsa State Nigeria.

2. MATERIALS AND METHODS

2.1. Study Area

The research was conducted in Yenagoa, which is located in Bayelsa State, Nigeria.

2.2. Approval for Ethical Considerations

This study, which received ethical approval from the College of Health Sciences ethical committee at Niger Delta University, was conducted in strict adherence to the principles outlined in the World Medical Association Declaration of Helsinki - Ethical Principles of 1975, as revised in 2008. In addition, all recruited subjects provided oral informed consent.

2.3. Experimental Design

The study was conducted on 105 seemingly healthy people who were chosen randomly and divided into three groups as follows:

2.4. Control Group

This group comprised of thirty-five seemingly robust individuals who are not involved in small-scale trading and fall between the ages of 28 and 45 years.

2.5. Experimental Group One

The sample group comprised of thirty-five seemingly robust small-scale merchants with less than six years of trading expertise, falling within the age bracket of 28 to 45 years.

2.6. Experimental Group Two

The sample group comprised of thirty-five seemingly robust small-scale merchants with 6-12 years of commercial expertise, aged between 28 and 45 years.

2.7. Collection of Samples

Each participant had five millilitres of blood specimens taken using a venipuncture procedure. The blood was then discharged into lithium heparin anti-coagulated bottles respectively. The contents of each bottle were meticulously mixed to guarantee uniformity and prevention of blood clotting. Afterwards, these specimens were spun at a speed of 2,500 revolutions per minute using a macro-centrifuge. The plasma that was obtained was subsequently utilised to assess the following biochemical parameters: cadmium, lead, glutathione peroxidase, malondialdehyde, interleukin-6, and C-reactive protein.

2.8. Inclusion and Exclusion Criteria

All the participants that were recruited for this study were deemed to be in good health with no signs of illness. Additionally, they were experienced petty traders, with one group having less than 6 years of experience and the other group having between 6 and 12 years of experience. This study eliminated individuals who exhibited signs of poor health and showed evidence of addiction to cigarette smoking, snuffing, and drug misuse.

2.9. Laboratory Analysis

Analysis in the laboratory was conducted to measure several biochemical parameters as shown below:

2.9.1. Cadmium

The measurement was conducted using the solar thermo-elemental atomic absorption spectrophotometry method, specifically with model number SE-71906, as outlined by Emmanuel T *et al,* 2023.

2.9.2. Lead

The measurement was conducted using the solar thermo-elemental atomic absorption spectrophotometry method, specifically with model number SE-71906, as outlined by Emmanuel T *et al,* 2023.

2.9.3. Glutathione peroxidase

The measurement was conducted using the ultraviolet (UV) technique outlined by Bio-diagnostic, located at 29 Tahreer Street, Dokki, Giza, Egypt, as described by Kshipra C *et al,* in 2018.

2.9.4. Malondialdehyde

The thiobabituric acid method, originally reported by Bio-diagnostic, 29 Tahreer Street, Dokki, Giza, Egypt, and subsequently modified by Wali U *et al,* 2020 was employed.

2.9.5. Interleukin-6

The elascience approach with catalogue number E-EL-HO.102 which was later modified by Egoro E *et al,* in 2023 was used.

2.9.6. C-reactive protein

The updated latex turbidimetry approach, developed by Emmanuel T *et al,* in 2020 and previously exhibited by Spinreact Diagnostic Spain, was utilised.

2.9.7. Statistical Analysis

The statistical analysis entailed the categorization of data into control and experimental groups, which were subsequently examined using SPSS version 23.0. The data's means and standard deviations were calculated using the student "t" test, and statistical significance was determined with a p-value of less than 0.05 for all groups.

3. RESULTS

The measured biochemical parameters in the control and experimental group one participants are presented in Table 1.

Table 1: Biochemical Parameters in Control Group Participants Compared with that of Experimental Group One

Parameters	ontrol group (n=20)	Experimental group (n=20)	p-value		Comment
Cadmium (µg/dI)	0.04 ± 0.01	0.05 ± 0.02	0.91		NS
Lead (µg/dl)	0.20 ± 0.02	0.22 ± 0.02	0.87		NS
GPx (µmol/L)	2.71 ± 0.19	2.72 ± 0.22	0.95		NS
MDA (µmol/L)	2.84 ± 0.21	2.87 ± 0.25	0.92		NS
IL-6 (pg/ml)	8.24 ± 0.83	10.26 ± 0.97	0.02		S
CRP (mg/L)	4.72 ± 0.43	9.75 ± 0.52	0.02		S

Values are in mean ± SD

Keys:

GPx = Glutathione peroxidase; MDA = Malondialdehyde; IL-6 = Interleukin -6; CRP = C-reactive protein; NS = Not statistically significant; n = Number of participants

The results from this Table showed that the mean values of all the measured biochemical parameters with the exception of interleukin-6 and C-reactive protein were not significantly altered.

The results of the measured biochemical parameters in the control and experimental group two participants are as shown in Table 2

Table 2: Biochemical Parameters in Control Group Participants Compared with that of Experimental Group Two

Parameters	Control group (n=20)	Experimental group (n=20)	p-value	Comment
Cadmium (µg/dl)	0.04 ± 0.01	0.14 ± 0.02	0.03	S
Lead (µg/dl)	0.20 ± 0.02	0.93 ± 0.03	0.02	S
GPx (µmol/L)	2.71 ± 0.19	4.85 ± 1.23	0.02	S
MDA (µmol/L)	2.84 ± 0.21	5.21 ± 1.30	0.02	S
IL-6 (pg/ml)	8.24 ± 0.83	12.66 ± 1.24	0.01	S
CRP (mg/L)	4.72 ± 0.43	14.72 ± 1.35	0.01	S

Values are in mean ± SD

Keys:
GPx = Glutathione peroxidase; MDA = Malondialdehyde; IL-6 = Interleukin -6; CRP = C-reactive protein; S = statistically significant; n = Number of participants

The results from this Table showed that the mean values of all the measured biochemical parameters were significantly elevated

4. DISCUSSION

In this study a comparison was made between the control group and the experimental groups, respectively. Toxic heavy metals are a category of metals with high density that can be toxic to humans, even at low doses (Monisha J *et al,* 2014). This study examined the levels of two dangerous heavy metals, cadmium and lead, among petty merchants with less than 6 years and between 6-12 years of trading experience. The measurements were conducted on two experimental groups, referred to as experimental group one and experimental group two, as shown in Table 1 and Table 2, respectively. The measurement of these harmful heavy metals was conducted due to their significant contribution to air pollution when produced from vehicle engines powered by petrol (Mousavi S *et al,* 2013). The average values of cadmium (0.05 ± 0.02) µg/dl, (p = 0.91) and lead (0.22 ± 0.02) µg/dl, (p = 0.87) in the members of experimental group one (Table 1) showed no significant changes when compared to the levels of cadmium (0.04 ± 0.01) µg/dl and lead (0.20 ± 0.02) µg/dl in the control group. This finding contradicts the previous research conducted by Lukman A, 2015 who reported significant elevations of (11.63 ± 1.73) µg/dl for cadmium and Jalab J *et al,* 2013 who reported significant elevations of (6.76 ± 5.96) µg/dl for lead among petty traders within this category.

Anti-oxidants are naturally occurring substances that counteract the harmful effects of free radicals (Stephen C *et al,* 2016), which are produced during normal metabolic processes and as a result of exposure to environmental pollutants such as pollution and cigarette smoke (Al-Akbar S *et al,* 2015). The study aimed to evaluate oxidative stress levels in two groups of individuals who work as petty traders. Group one consisted of individuals with less than 6 years of trading experience, while group two consisted of individuals with 6-12 years of trading experience. The levels of glutathione peroxidase and malondialdehyde were evaluated to determine oxidative stress, as shown in Table 1 and Table 2, respectively.

Table 1 demonstrated that the average values of glutathione peroxidase (2.72 ± 0.22) µmol/L, (p=0.95) and malondialdehyde (2.87 ± 0.25) µmol/L, (p=0.92) were not substantially changed in the experimental group one participants compared to the control group's glutathione peroxidase (2.71 ± 0.19) µmol/L and malondialdehyde (2.84 ± 0.21) µmol/L. These findings are as established in this study as relevant literatures on past works to compare our findings with are scarce.

C-reactive protein is a type of protein that belongs to the pentraxin family. It is increased in response to infection and inflammation (Christopher B *et al,* 2016). Interleukin-6 on the other hand is an inflammatory cytokine involved in a broad aspect of biological effects with a great significance in pathological pain development (Zhou Y *et al,* 2016).

Table 1 further demonstrates that the average values of interleukin-6 (10.26 ± 0.97) µmol/L, (p=0.02) and C-reactive protein (9.75 ± 0.52) mg/L (p=0.02) were significantly elevated in the experimental group one participants compared to the control group's interleukin-6 (8.24 ± 0.83) pg/ml and C-reactive protein (4.72 ± 0.43) mg/L. This finding which is presumed to be due to the systemic response of the traders in this category following their exposure to toxic chemicals such as cadmium, lead, carbon monoxide etc in the air by virtue of their occupation, thus leading to inflammation with the resultant release of interleukin-6 as well increased synthesis of C-reactive protein is in agreement with the past work of Emmanuel T *et al,* 2021.

However, in the experimental group two, the average levels of cadmium (0.14 ± 0.02) µg/dl, (p=0.03) and lead (0.93 ± 0.03) µg/dl, (p=0.02) were significantly higher compared to the control group's levels of cadmium (0.04 ± 0.01) µg/dl and lead (0.20 ± 0.02) µg/dl. This information is presented in Table 2. This outcome which may influence adverse effects on some vital organs in humans as reported by Monisha J *et al.* (2014) is presumed to be associated with the 6-12 years exposure and subsequent inhalation of cadmium and lead emitted to the atmosphere from vehicle exhaust that use petrol. This finding is found to be consistent with the earlier research conducted by Lukman A, 2015 for cadmium and Jalab J *et al,* 2013 for lead who in their respective research reported (11.63 ± 1.73) µg/dl for cadmium and (6.76 ± 5.96) µg/dl for lead.

According to Table 2, the average values of glutathione peroxidase (4.85 ± 1.23) µmol/L, (p=0.02) and malondialdehyde (5.21 ± 1.30) µmol/L, (P=0.02) were considerably elevated in the experimental group two participants compared to the control group's glutathione peroxidase (2.71 ± 0.19) µmol/L and malondialdehyde (2.84 ± 0.21) µmol/L. Based on the paucity of relevant literatures by previous researchers to compare our finding with, we conclude that this finding which may be attributed to the first line defensive action by these antioxidants in a bid to inhibit the excessive production of reactive oxygen species following the exposure and inhalation of toxic chemicals such as lead, cadmium, carbon monoxide etc in the air is as established in this present study. These elevations may be suggestive

of oxidative stress associated with this category of petty traders.

This study assessed interleukin-6 and C-reactive protein levels to assess inflammatory disorders in two groups of petty traders. The first group had less than 6 years of trading experience (experimental group one), while the second group had between 6-12 years of trading experience (experimental group two). The results are presented in Table 1 and Table 2, respectively.

The mean values of interleukin-6 (12.66 ± 1.24) pg/ml, (p = 0.01) and C-reactive protein (14.72 ± 1.35) mg/L, (p = 0.01) are elevated significantly among the petty traders with working experience of 6-12 years experimental group two as shown in Table 2 in comparison with that of the control group interleukin-6 (8.24 ± 0.83) pg/ml and C-reactive protein (4.72 ± 0.43) mg/L. As earlier reported in this study the elevation of this biomarkers which is consistent with the previous work of Emmanuel T *et al,* 2021 may be associated with the systemic response of the traders in this category following their exposure and subsequent inhalation of some toxic chemicals in the air such as cadmium, lead, carbon monoxide etc by virtue of their occupation, thus leading to inflammation with the resultant release of interleukin-6 as well increased synthesis of C-reactive protein.

CONCLUSION

Ultimately, individuals engaged in small-scale commerce (petty trading) for a period of 6-12 years are susceptible to the harmful effects of heavy metals, specifically cadmium and lead poisoning, as well as oxidative stress and inflammatory disorders, while those for lesser than 6 years are not at the risk of cadmium and lead poisoning, as well as oxidative stress, but at risk to inflammatory disorders.

Recommendation

It is advisable for small-scale traders for a period of 6-12 years to make an effort to get regular medical examinations.

Conflicts of Interest

There is none

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